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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/317,536	05/24/99	ZHAO	B 97RSS256-DIV

EXAMINER	
OWENS, D	
ART UNIT	**PAPER NUMBER**
2811	

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DATE MAILED: 10/24/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Application No.	Applicant(s)	
	09/317,536	ZHAO ET AL.	
	Examiner	Art Unit	
	Douglas W Owens	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 July 2001* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *16-34* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *16-34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

Drynan et al. and Claims 16, 19, 20 and 23

2. Claims 16, 19, 20, 23 and 34 are rejected under 35 U.S.C. 102(e) as being anticipated by US patent No. 5,929,524 to Drynan et al.

Regarding claim 16, Drynan et al. teaches an interconnect (Fig. 2C), comprising:

one or more metal lines (118ad, 108ae) in a first metal layer;

a low-k material with a height and vertical portions (112) (See page 9, line 17 of instant application) filling gaps between the metal lines;

a protective layer (113, 116a) over the metal lines and low-k material, wherein the protective layer covers at least one vertical portion of the low-k material;

a dielectric layer (122) over the protective layer;

a via in the dielectric layer;

a metal (137a) filling the via;

a second metal layer (138ab) over the dielectric layer; and

an opening in the protective layer to allow metal in the via to contact the metal lines.

Regarding claim 19, Drynan et al. teaches an interconnect, wherein the protective layer includes dielectric material.

Regarding claims 20 and 23, Drynan et al. teaches an interconnect, wherein the protective layer is silicon nitride.

Havemann and Claims 28 and 29

3. Claims 28 and 29 are rejected under 35 U.S.C. 102(b) as being anticipated by Havemann et al., US patent No. 5,747,880.

Regarding claim 28, Havemann et al. teaches an interconnect structure comprising:

a plurality of metal lines (24) on a substrate;

a low-k dielectric (28) between the metal lines;

a second dielectric (30) above the metal lines;

a protective layer (56) between the second dielectric and the low-k dielectric; and

a conductive feature (32) within the second dielectric and the protective layer, wherein the conductive feature is in contact with at least one of the metal lines.

It is inherent that the protective layer and the second dielectric layer would have had etch selectivity since they comprise different materials. (Col. 7, lines 1-8, Col. 8, lines 5-9)

Regarding claims 29, Havemann et al. teaches an interconnect, wherein the protective layer comprises a dielectric material.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Drynan et al. and claims 17, 18, 21, 22 and 24-27

5. Claims 17, 18, 21, 22 and 24-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Drynan et al.

Regarding claims 17 and 18, Drynan et al. teaches an interconnect, wherein the protective layer is silicon nitride. Drynan et al. does not teach an interconnect, wherein the protective layer is silicon dioxide. It would have been a matter of obvious design choice to use silicon dioxide in place of silicon nitride since it is a known material that is well suited for the intended use, and has properties that are similar to silicon nitride.

Regarding claim 21, Drynan et al. teaches an interconnect, wherein the protective layer is silicon nitride. Drynan et al. does not teach an interconnect, wherein the protective layer is silicon carbide. It would have been a matter of obvious design choice to use silicon carbide in place of silicon nitride since it is a known material that is well suited for the intended use, and has properties that are similar to silicon nitride.

Regarding claim 22, Drynan et al. does not teach an interconnect, comprising a spacer on the vertical portion of the low-k material. It is conventional in the art to provide spacers in vias where metal fills are preformed for various reasons. It would

have been obvious to one of ordinary skill to include a spacer on the vertical portion since it is desirable to prevent lateral diffusion of impurities, among other reasons.

Regarding claims 24 and 25, Drynan et al. teaches an interconnect, wherein the metal filling the vias is tungsten (Col. 18, lines 58-63 and Col. 21, lines 8-11). Drynan et al. does not teach an interconnect, wherein the first and second metal layer or the metal filling the via is an aluminum alloy. The use of aluminum alloys in interconnects is well-known in the art. It would have been obvious to one of ordinary skill to use an aluminum alloy, since it is a known material that is well suited for the intended use.

Regarding claims 26 and 27, Drynan et al. teaches an interconnect, wherein the protective layer is silicon nitride. Drynan et al. does not teach an interconnect, wherein the protective layer is silicon dioxide. It would have been a matter of obvious design choice to use silicon dioxide in place of silicon nitride since it is a known material that is well suited for the intended use, and has properties that are similar to silicon nitride. Drynan et al. does not teach an organic low-k material or porous silicon dioxide. Organic low-k materials and porous oxides are known in the art for their low dielectric constants. It would have been obvious to one of ordinary skill to incorporate either of these known materials since it is desirable to reduce capacitance in interconnect structures.

Havemann and Claims 30 and 31

6. Claims 30 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al.

Regarding claims 30 and 31, Havemann et al. does not teach an interconnect, including a liner, wherein said liner comprises material selected from the group consisting of titanium, titanium nitride, tantalum, tantalum nitride, aluminum, copper, and tungsten nitride. It is conventional in the art to include liners in interconnect devices. It would have been obvious to one of ordinary skill in the art to incorporate a liner since it is desirable to prevent unwanted diffusion of impurities. Additionally, many of the materials listed for use in the liner are known to have barrier properties. It would have been obvious to one of ordinary skill to select a known material that is suited for the intended use.

Havemann and Chen Applied to Claims 32 and 33

7. Claims 32, and 33 rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. as applied to claims 28-31 above, and further in view of Chen et al.

Regarding claim 32, Havemann et al. does not teach a spacer between the low-k dielectric and the conductive material. Chen teaches an interconnect wherein a spacer is disposed on the vertical portion of the dielectric. It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teaching of Chen into Havemann's device, since the sidewall spacer would have prevented lateral diffusion of impurities.

Regarding claim 33, neither Havemann et al., nor Chen teach an interconnect including a liner over a spacer. The incorporation of the additional layer comprising the liner is conventional in the formation of interconnect structures. It would have been

obvious to one of ordinary skill in the art to incorporate such a liner since it is desirable to prevent the vertical diffusion of impurities.

Response to Arguments

8. Applicant's arguments filed July 17, 2001 have been fully considered but they are not persuasive.

The applicant argues that Drynan et al. does not teach the use of a low-k material. Drynan et al. teaches the use of BPSG, which can have a dielectric constant in the range of 3.6 to 3.9, disclosed in US patent No. 5,773,361 to Cronin et al. in lines 31 and 32 of column 1 (enclosed for applicant's convenience). BPSG is frequently referred to in the art as a low-dielectric constant insulator. For the applicant's convenience, the following patents have been enclosed showing the use of BPSG for a low-k insulator:

US patent No. 5,834,348 to Kwon et al. (Col. 4, lines 29-33)
US patent No. 5,914,851 to Saenger et al. (Claim 6)
US patent No. 6,077,774 to Hong et al. (Col. 2, lines 63-66)
US patent No. 6,115,233 to Seliskar et al. (Col. 3, lines 60-62)

The applicant argues that Havemann et al. does not teach a protective layer configured to provide etch selectivity between the protective layer and the second dielectric layer because they may both be fabricated from the same material. The protective layer and the second dielectric layer may also be fabricated from different materials. Havemann et al. discloses that layer 28 may be fabricated from "...silicon dioxide, silicon nitride, a composite layer having silicon dioxide and silicon nitride layers, silicon oxynitride, an organic layer or similar materials..." (Col. 7, lines). Havemann et al. only discloses using silicon dioxide for layer 56 (Col 8, lines 7 and 8). Therefore, it

can be seen that there are several materials that may used for layer 28, while only one material is disclosed for layer 56. It is indeed inherent that the protective layer and the second dielectric layer would have had etch selectivity since they may comprise different materials. The applicant further argues that etch selectivity was not a part of the invention taught by Havemann et al. or was not a critical feature. Although the applicant may have found this feature to be of critical importance, where Havemann et al may or may not have, the feature is none the less anticipated by Havemann et al. The fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

The applicant argues that it would not have been obvious to combine Havemann et al. and Chen et al. because Havemann et al. does not teach a protective layer that is configured to provide etch selectivity. This argument has been addressed above.

Conclusion

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Douglas W Owens whose telephone number is 703-308-6167. The examiner can normally be reached on Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 703-308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

DWO
October 16, 2001

Steven Loke
Primary Examiner